

WHAT IS CLAIMED IS:

1           1. A method of detecting the presence of special nuclear materials in a  
2 container, comprising:

3                 irradiating the container with an energetic beam, so as to induce a fission in  
4 the special nuclear materials;

5                 detecting the gamma rays that are emitted from the fission products formed by  
6 said fission, to produce a detector signal;

7                 comparing the detector signal with a threshold value to form a comparison;  
8 and

9                 detecting the presence of the special nuclear materials using the comparison.

1           2. The method of claim 1 wherein said irradiating comprises irradiating  
2 said container with a beam of neutrons.

1           3. The method of claim 1 wherein said irradiating comprises irradiating  
2 said container with a deuterium produced beam of neutrons.

1           4. The method of claim 1 wherein said irradiating comprises irradiating  
2 said container with a tritium produced beam of neutrons.

1           5. The method of claim 1 wherein said irradiating comprises irradiating  
2 said container with a gamma-ray beam capable of adding sufficient energy to the nucleus of  
3 the special nuclear material to overcome the fission barrier and thus induce a fission in the  
4 special nuclear material.

1           6. The method of claim 1 wherein said irradiating comprises irradiating  
2 said container in order to induce a thermal fission in the special nuclear materials and to  
3 produce short-lived and high-energy gamma rays that are emitted from the resulting fission  
4 products.

1           7. The method of claim 6 wherein said short-lived gamma rays comprise  
2 gamma rays that have a half-life that is smaller than approximately 1 minute.

1           8. The method of claim 6 wherein said short-lived gamma rays comprise  
2 gamma rays that have a half-life that is smaller than approximately thirty seconds.

1                   9.       The method of claim 6 wherein said high-energy gamma rays are  
2   gamma-ray that have an energy that is higher than approximately 3MeV.

1                   10.      The method of claim 6 wherein said high-energy gamma rays are  
2   gamma-ray that have an energy that is higher than approximately 4MeV.

1                   11.      The method of claim 1 wherein said detecting is conducted using a  
2   germanium detector.

1                   12.      The method of claim 1 wherein said detecting is conducted using a  
2   liquid scintillation detector.

1                   13.      The method of claim 1 wherein said detecting is conducted using a  
2   plastic scintillation detector.

1                   14.      The method of claim 1 wherein said detecting is conducted after a time  
2   period after the cessation of said irradiating.

1                   15.      The method of claim 1 wherein said detecting is conducted for a time  
2   period after the cessation of said irradiating.

1                   16.      The method of claim 1 wherein said detecting comprises detecting the  
2   energy characteristics of the gamma rays.

1                   17.      The method of claim 16 wherein said energy characteristics comprises  
2   an energy spectrum of the gamma rays.

1                   18.      The method of claim 17 wherein said energy spectrum comprises a  
2   measure of the number of detected gamma-rays as a function the energies of the detected  
3   gamma rays.

1                   19.      The method of claim 16 wherein said energy characteristics comprises  
2   a measure of the time dependence of the yield of the gamma rays.

1                   20.      The method of claim 1 wherein said comparing the detector signal with  
2   a threshold value comprises comparing the energy level of the detected gamma rays with an  
3   energy threshold value.

1               21.     The method of claim 1 wherein said comparing the detector signal with  
2 a threshold value comprises comparing the time dependence of the detected gamma ray  
3 yields with a half-life threshold value.

1               22.     The method of claim 1 wherein said detecting the presence of the  
2 special nuclear materials using the comparison is configured to detect said presence when the  
3 energy of the detected gamma rays is higher than an energy threshold value.

1               23.     The method of claim 22 wherein said energy threshold value is  
2 approximately 3 MeV.

1               24.     The method of claim 22 wherein said energy threshold value is  
2 approximately 4 MeV.

1               25.     The method of claim 1 wherein said detecting the presence of the  
2 special nuclear materials using the comparison is configured to detect said presence when the  
3 half-life of the detected gamma rays is less than a half-life threshold value.

1               26.     The method of claim 25 wherein said half-life threshold value is  
2 approximately 20 seconds.

1               27.     The method of claim 25 wherein said half-life threshold value is  
2 approximately between 20 and 30 seconds.

1               28.     The method of claim 1 wherein said detecting the presence of the  
2 special nuclear materials using the comparison is configured to detect said presence when the  
3 energy of the detected gamma rays is higher than an energy threshold value and when the  
4 half-life of the detected gamma rays is less than a half-life threshold value.

1               29.     A method of detecting the presence of special nuclear materials in a  
2 container, comprising:

3               irradiating the container with an energetic beam in order to induce a fission in  
4 the special nuclear materials and to produce short-lived and high-energy gamma rays that are  
5 emitted from the resulting fission products;

6               detecting the gamma rays that are emitted from the fission products formed by  
7 said fission, to produce a detector signal;

8                         comparing the detector signal with a threshold value to form a comparison;

9       and

10                         detecting the presence of the special nuclear materials using the comparison,  
11       wherein said detecting is configured to detect said presence when the energy of the detected  
12       gamma rays is higher than an energy threshold value and when the half-life of the detected  
13       gamma rays is less than a half-life threshold value.

1                         30.       A system for detecting the presence of special nuclear materials in a  
2       container, comprising:

3                         an energetic beam source configured for irradiating the container, so as to  
4       induce a fission in the special nuclear materials;

5                         a detector configured for detecting the gamma rays that are emitted from the  
6       fission products formed by said fission, to produce a detector signal;

7                         a comparator for comparing the detector signal with a threshold value to form  
8       a comparison; and

9                         a presence detector for detecting the presence of the special nuclear materials  
10      using the comparison.

1                         31.       The system of claim 30 wherein said energetic beam source comprises  
2       a beam of neutrons.

1                         32.       The system of claim 30 wherein said energetic beam source comprises  
2       a deuterium neutron source.

1                         33.       The system of claim 30 wherein said energetic beam source comprises  
2       a tritium neutron source.

1                         34.       The system of claim 30 wherein said energetic beam source comprises  
2       a gamma-ray beam capable of adding sufficient energy to the nucleus of the special nuclear  
3       material to overcome the fission barrier and thus induce a fission in the special nuclear  
4       material.

1                         35.       The system of claim 30 wherein said energetic beam source is  
2       configured for irradiating said container in order to induce a thermal fission in the special  
3       nuclear materials and to produce short-lived and high-energy gamma rays that are emitted  
4       from the resulting fission products.

1                   36.     The system of claim 35 wherein said short-lived gamma rays comprise  
2     gamma rays that have a half-life that is smaller than approximately 1 minute.

1                   37.     The system of claim 35 wherein said short-lived gamma rays comprise  
2     gamma rays that have a half-life that is smaller than approximately thirty seconds.

1                   38.     The system of claim 35 wherein said high-energy gamma rays are  
2     gamma-ray that have an energy that is higher than approximately 3MeV.

1                   39.     The system of claim 35 wherein said high-energy gamma rays are  
2     gamma-ray that have an energy that is higher than approximately 4MeV.

1                   40.     The system of claim 30 wherein said detector comprises a germanium  
2     detector.

1                   41.     The system of claim 30 wherein said detector comprises a liquid  
2     scintillator detector.

1                   42.     The system of claim 30 wherein said detector comprises a plastic  
2     scintillator detector.

1                   43.     The system of claim 30 wherein said detector is configured to detect  
2     the gamma rays after a time period after the cessation of said irradiating.

1                   44.     The system of claim 30 wherein said detector is configured to detect  
2     said gamma rays for a time period after the cessation of said irradiating

1                   45.     The system of claim 30 wherein said detector is configured for  
2     detecting the energy characteristics of the gamma rays.

1                   46.     The system of claim 45 wherein said energy characteristics comprises  
2     an energy spectrum of the gamma rays.

1                   47.     The system of claim 46 wherein said energy spectrum comprises a  
2     measure of the number of detected gamma-rays as a function the energies of the detected  
3     gamma rays.

1                  48.        The system of claim 45 wherein said energy characteristics comprises  
2 a measure of the time dependence of the yield of the gamma rays.

1                  49.        The system of claim 30 wherein said comparator is configured for  
2 comparing the energy level of the detected signal with an energy threshold value.

1                  50.        The system of claim 30 wherein said comparator is configured for  
2 comparing the time dependence of the detected gamma ray yields with a half-life threshold  
3 value.

1                  51.        The system of claim 30 wherein said presence detector is configured to  
2 detect said presence when the energy of the detected gamma rays is higher than an energy  
3 threshold value.

1                  52.        The system of claim 51 wherein said energy threshold value is  
2 approximately 3 MeV.

1                  53.        The system of claim 51 wherein said energy threshold value is  
2 approximately 4 MeV.

1                  54.        The system of claim 30 wherein said presence detector is configured to  
2 detect said presence when the half-life of the detected gamma rays is less than a half-life  
3 threshold value.

1                  55.        The system of claim 54 wherein said half-life threshold value is  
2 approximately 20 seconds.

1                  56.        The system of claim 54 wherein said half-life threshold value is  
2 approximately between 20 and 30 seconds.

1                  57.        The system of claim 30 wherein said presence detector is configured to  
2 detect said presence when the energy of the detected gamma rays is higher than an energy  
3 threshold value and when the half-life of the detected gamma rays is less than a half-life  
4 threshold value.

1                  58.        A system for detecting the presence of special nuclear materials in a  
2 container, comprising:

3                   an energetic beam source configured for irradiating the container in order to  
4   induce a fission in the special nuclear materials and to produce short-lived and high-energy  
5   gamma rays that are emitted from the resulting fission products;

6                   a detector configured for detecting the gamma rays that are emitted from the  
7   fission products formed by said fission, to produce a detector signal;

8                   a comparator for comparing the detector signal with a threshold value to form  
9   a comparison; and

10                  a presence detector for detecting the presence of the special nuclear materials  
11   using the comparison, wherein said presence detector is configured to detect said presence  
12   when the energy of the detected gamma rays is higher than an energy threshold value and  
13   when the half-life of the detected gamma rays is less than a half-life threshold value.

1                 59.    A system for detecting the presence of special nuclear materials in a  
2   container, comprising:

3                   means for irradiating the container with an energetic beam, so as to induce a  
4   fission in the special nuclear materials;

5                   means for detecting the gamma rays that are emitted from the fission products  
6   formed by said fission, to produce a detector signal;

7                   means for comparing the detector signal with a threshold value to form a  
8   comparison; and

9                   means for detecting the presence of the special nuclear materials using the  
10   comparison.

1                 60.    The system of claim 59 wherein said means for irradiating comprises  
2   an energetic beam source configured for irradiating said container in order to induce a fission  
3   in the special nuclear materials and to produce short-lived and high-energy gamma rays that  
4   are emitted from the resulting fission products.